

SECTION F, PART 0

INTERMARKER GROUP CALL TROUBLE CARD ANALYSIS

Index

		<u>PAGE</u>
FO	INTERMARKER GROUP CALL TROUBLE CARD ANALYSIS	F0-2
FO-1	FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART	F0-2
FO-1.1	USE OF FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART	F0-2
FO-2	SEQUENCE CHARTS	F0-3
FO-3	CROSS DETECTION, SEQUENCE FAILURE (SFD-F002,F003)	F0-4
FO-4	TIMING FUNCTIONS	F0-4
FO-4.1	OVERALL TIMER (OAT)	F0-4
FO-4.2	WORK TIMER (WT)	F0-4
FO-4.3	SHORT DELAY TIMER (SDT) AND LONG DELAY TIMER (LDT)	F0-5
FO-4.4	TRANSFER START TIMER (TRS)	F0-5
FO-5	FALSE CROSS-GROUND TEST (FCG)	F0-5

FO INTERMARKER GROUP CALL TROUBLE CARD ANALYSIS

The trouble analysis flow charts on SFD-A2-- direct the user to one of the oblong boxes† on the left of SFD-F002 (calling marker group) or SFD-F003 (called marker group) for intermarker group call trouble record cards. The flow chart supplies information and directs the user to the trouble analysis sequence chart which in turn refers to a sequence chart.

FO-1 FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART

The flow charts on SFD-F002 and SFD-F003 are used in the same manner as the trouble analysis flow charts on SFD-A2--. The user, having determined the type of call and stage from SFD-A2, is directed to SFD-F002 or SFD-F003. Then by observing the trouble record card and making decisions the craft person is supplied needed information or directed to the trouble analysis sequence chart.

Standard SD sequence charts generally show a sequence of relay operation and release. All relays are shown that relate to a particular function. Trouble record punch indications are shown at the point in the sequence when ground is applied to or removed from the lead to the trouble recorder. Trouble analysis sequence charts omit relays shown on the regular sequence chart, except those relays associated with the trouble record designations (SFD-A103). A designation on the trouble analysis sequence chart without a punch symbol indicates the point in the sequence where that designation would be punched if a trouble record were taken. A designation with a triangle (base down) to its right indicates the point in the sequence after which a designation would not be punched.

FO-1.1 USE OF FLOW CHART AND TROUBLE ANALYSIS SEQUENCE CHART

These paragraphs will demonstrate the use of the flow chart (SFD-F002/F003) and the trouble analysis sequence chart (SFD-F004/F005). A crafts person experienced in the use of trouble record cards may find this section basic, but the procedures shown here (even though they may become automatic) are the procedures a qualified crafts person must perform.

Without a selection of trouble record cards to distribute to the reader, certain functions must be assumed. It is assumed that all trunks, trunk links, line links, senders, etc. vary. The only equipment that remains the same on all cards is the marker. Following the flow chart (SFD-F002/F003), it is identified that the MXT punch is not indicated. The path to follow is marked N(No). The WT punch is indicated on the trouble record. The path to follow is marked Y(Yes). This procedure continues through the FCG N(No), the TK Y(Yes), the HMS1 Y(Yes), and the DCT1 N(No). The flow chart directs the reader to SFD-F004/F005.

† Symbols used in flow chart are described on SFD-A103.

The trouble analysis sequence chart, and all sequence charts, operate from the top of the page to the bottom. To identify the trouble area the reader must start at that point of major failure and back-track to the point where all punch indications (leading to the branch in trouble) are shown.

To demonstrate the procedure when analyzing a trouble record in the calling marker group (SFD-F004): Working back from the DCT1, the GT2 is indicated, the DCT is indicated, and the AVK1 is not indicated. (The reader must now follow the path from the AVK1). The RSC is indicated, the SLK2 is not indicated, and the SLK1 is indicated. There are no other paths leading to the SLK2. The problem exists between the SLK1 and SLK2 indications. The page coordinate at A7 shows the portion of the trouble analysis sequence chart that is shown in detail on F202. Use of the sequence chart on F202 will be described in paragraph F0-2.

To demonstrate the procedure when analyzing a trouble record in the called marker group (SFD-F005): Working back from the TK (not indicated), the LCK is not indicated, the SNG is not indicated, the CKG is not indicated, the TM is indicated. The problem exists between the CKG and TM. The page coordinate at A1 shows the portion of the trouble analysis sequence chart that is shown in detail on F502. Use of the sequence chart on F502 will be described in paragraph F0-2.

F0-2 SEQUENCE CHARTS

The sequence charts used in the SFD follow standard conventions for sequence charts, except as noted on SFD-A103.

The example in F0-1.1 demonstrating the procedure used when analyzing a trouble record in the calling marker group is continued on SFD-F202. The SLK1 punch checks that the SLK relay operates. The SLK relay checks that the SHKA operates. The relays now involved are the SH hold magnet (OSL), ON, SR, LR and T/R/D relays in the intermarker group sender, the S1 in the trunk, and the release of the SLK in the marker. Caution is necessary at this point. When conditions were established for this example, the only equipment that remained unchanged on all cards was the marker. One might assume that relays in the senders, trunks and OSL (and their operations) could be eliminated. However, this is definitely not true. The physical wiring and apparatus can be eliminated, but the lead to operate the S1 relay in the trunk extends to the marker and cannot be eliminated. The S1 relay should be checked to see if it operates, and then the path to the SLK2 checked.

The example in F0-1.1 demonstrating the procedure used when analyzing a trouble record in the called marker group is continued on SFD-F502. The TM punch checks that the MAK, MCK and MSK relays have released. The MAK, MCK and MSK check that the MS relay (PC) has operated. The relays now involved are the M- (IRMC) and CKG-. The M- relays in the IRMC should be checked to see if they operate and then the path to the CKG- in the marker.

FO-3 CROSS DETECTION, SEQUENCE FAILURE (SFD-F002,F003)

For either of the double sided trouble cards, there is an MXT designation which is punched if there is a cross detected (X--) or if there is a sequence failure (SQA) of the junctor walking circuit. For the single sided trouble card, there is no MXT punch and it is necessary to scan all the X-- designations and the SQA designation to determine if there is a cross or sequence failure. The reader should proceed through each decision box following Y(yes) if the designation is punched or the statement is true, or N(no) if the designation is not punched or the statement is not true. If there is no MXT or SQA, cross or sequence failure, the procedure beyond that point is the same for all trouble record cards.

FO-4 TIMING FUNCTIONS

The DTM and CM are designed in such a way that they are timed from seizure until release. Critical functions are timed separately. Understanding the purpose and function of timing circuits will aid the crafts person in understanding the behavior of the marker. General functions of the OAT, WT, SDT/LDT, and TRS timers will be discussed in this section. More detailed description of timing operations can be found in the SCD-C1 section.

FO-4.1 OVERALL TIMER (OAT)

The OAT is started when the CM is seized and is stopped when the marker is restored to normal. The timing interval is 9.6 to 15.4 seconds which is greater than the time required on any normal marker usage. This timer guards against failure of any of the other timers. Operation of the timer causes the marker to release without a trouble record but will sound a major alarm.

FO-4.2 WORK TIMER (WT)

The WT timer is started when the marker is seized and is stopped when the marker is restored to normal. The timing interval is 450 to 605 milliseconds. This short timer is used to detect trouble as soon as possible in order to quickly release the marker. The WT timer is recycled as the call progresses. Operation of the WT causes the marker to take a trouble record before releasing and will be the timer that will most often generate a trouble record.

F0-4.3 SHORT DELAY TIMER (SDT) AND LONG DELAY TIMER (LDT)

The SDT provides a delay of 2.6 to 4.5 seconds on service calls and 1.1 to 1.9 seconds on no-test calls. The LDT provides a delay of 4.6 to 7.5 seconds. Both timers are started by the operation of the seize frame (SF) and seize frame timer (SFT) relays. The operation of the SF stops the WT timer. The SF and SFT relays operate when the marker closes a start lead to select a frame such as the LL, TL, NG, OSC or FAT. The SF and SFT relays also operate on various test calls and on completion of the sender trunk guard test. The SDT timer always functions first unless the trouble recorder is busy. This condition requires the longer timing provided by the LDT. If the SDT should fail, the LDT, which is also timing will function as a backup.

F0-4.4 TRANSFER START TIMER (TRS)

The TRS circuit functions to transfer the marker connector start leads to the alternate marker preference whenever a marker is not seized in approximately one second. If the WT, SDT/LDT are not punched and the TRS is punched, the trouble record indicates that the marker connector could not connect to a CM within the transfer start timing interval and had to transfer its start leads.

F0-5 FALSE CROSS-GROUND TEST (FCG)

The FCG is the next punch designation which must be considered on the flow chart (SFD-F002/F003) and will be discussed briefly at this time. During light traffic conditions the CM operates all hold magnets except the line hold magnet. The FCG relay is connected to the tip and ring leads and will operate if there is a cross between the tip and ring, a false ground on the ring conductor, or a false battery on the tip conductor. The FCG relay will lock operated, stop the marker progress, and force a WT time out.

SECTION F, PART 1

ESTABLISHING INTERMARKER GROUP CONNECTION
(SUBSCRIBER TO SUBSCRIBER)

Index

	<u>PAGE</u>
F ESTABLISHING INTERMARKER GROUP CONNECTION	F1-2
F1 INPUT TO CALLING COMPLETING MARKER AND CODE TRANSLATION	F1-3

F ESTABLISHING INTERMARKER GROUP CONNECTION

Intermarker group calls are requests for service between two No. 5 crossbar marker groups in the same building. There are three types of IMG calls; subscriber to trunk, trunk to subscriber, and subscriber to subscriber. The subscriber to subscriber IMG call will be the only type covered in the SFD and SCD. An IMG call requires a completing marker in each of the marker groups to complete the connection.

These calls do not require pulsing between marker groups but do require an intermarker group sender. The intermarker group sender operates as an outgoing sender in the calling marker group and as an incoming register in the called marker group. The called digits and the TL on which the IMG trunk appears in the called marker group are stored in the intermarker group sender. After the calling CM releases and the called completing marker is seized the information stored in the IMG sender is passed to the called CM through the IRMC. Other than the operations described above the intermarker group call is very similar to an outgoing call followed by an incoming call.

The general sequence of operation is as follows:

After dialing is completed, the originating register seizes a completing marker in the calling marker group in competition with other originating registers through preference and control circuits. The OR passes line location, class of service, line linkage (dial tone channel used), dialed digits, coin and 2-party information to the marker. The calling CM determines, from the translation of the dialed number and other input information received from the OR, the intermarker group route and operates the route relay.

The calling marker group is required to supply information to the called marker group. Intermarker group senders store the calling information received from the calling completing marker and pass this information to the completing marker in the called marker group. The calling CM determines that an intermarker group sender is needed and then selects and connects to a sender through the outsender connector. The calling marker then transmits the called digits and, if AMA is required, additional information to the sender. The completing marker performs many functions at the same time. Two functions performed at approximately the same time are sender and trunk functions. After the marker selects a trunk, and the F0 relay operates (part F3), the calling marker closes a path from the sender to the trunk through the outgoing sender link frame. The sender is now attached to the trunk and the trunk link on which the IMG trunk appears in the called marker group is stored in the intermarker group sender.

While the intermarker group sender connection is being established (part F2), the completing marker proceeds to select a trunk link frame having an idle trunk of the correct type. The calling completing marker then selects and connects to the intermarker group trunk through the TLC (trunk link connector) frame.

Following trunk link frame seizure, the line link frame on which the calling line is located is seized. This gives the CM access to, and control of, the calling line select and hold magnets.

Once the trunk and line link seizure is completed a connection between the line and trunk are made by closing the line switch and junctor switch crosspoints on the LL, and the junctor switch and trunk switch crosspoints on the TL. The select magnets and hold magnets involved in closing the specific crosspoints depend on the location of the line on the line switch, the trunk on the trunk switch, and the channel selected. After crosspoints are closed, the channel is checked for crosses, continuity and double connections.

Upon the successful completion of the double connection test and the ground test, the completing marker transmits an advance signal to the intermarker group sender. The calling completing marker then checks the functions in the sender, that linkage is properly set up, and releases.

Once the intermarker group sender is connected to the calling CM, control relays operate in the sender and the called digits and TLF number of the intermarker group trunk in the called marker group are stored in the IMG sender for later passage to the CM in the called marker group. After the connection in the called marker group is established the called CM releases which releases the intermarker group sender.

After the intermarker group sender has received an advance signal from the calling CM and the calling CM has released (part F4), the sender seizes a completing marker in the called marker group in competition with other intermarker group senders and IR's through preference and control circuits. The sender establishes a connection to the called completing marker through the IRMC and passes information to the CM that is used to complete the call.

After the called CM has been seized and has received input information through the IRMC from the intermarker group sender, it proceeds to connect to the TL (trunk link) frame which contains the intermarker group trunk. After the TL preference circuit functions, the CM connects to the intermarker group trunk. Trunk class information is passed from the trunk to the marker. The completing marker determines the location of the trunk on the trunk link and operates control relays and select magnets.

In a No. 5 crossbar office, there is no permanent or prearranged association of directory numbers with switch and vertical locations on the LL (line link) frames. The CM, after translating the called number, must determine which of the many line locations in the marker group is associated with that particular directory number. The completing marker obtains this information from the NG (number group) frame. The NG frame has a large cross connectable memory, line location to directory number, to which the CM applies for the necessary translation.

After the directory number has been translated, the LL containing the called line is seized to enable completing marker control of the desired select and hold magnets. This connection is referred to as FLG (call forward linkage).

Once the trunk and line location have been identified, a connection between the line and trunk are made by closing the line switch and junctor switch crosspoints on the LL, and the junctor switch and trunk switch crosspoints on the TL. The select magnets and hold magnets involved in closing the specific crosspoints depend on the location of the line on the line switch, the trunk on the trunk switch, and the channel selected. After crosspoints are closed, the channel is checked for crosses, continuity and double connections. The NG (number group) releases and the ringing switch crosspoints are closed.

After the called CM has verified the successful completion of the double connection test, ground test and closure of the ringing switch crosspoints, ringing is applied to the called line. The completing marker then checks that linkage is properly set up and proceeds to disconnect and restore to normal. Once the called completing marker has disconnected the intermarker group sender releases.

F1 INPUT TO CALLING COMPLETING MARKER AND CODE TRANSLATION

After dialing is completed, the originating register seizes a completing marker in the calling marker group in competition with other originating registers through preferences and control circuits. The OR passes line location, class of service, line linkage (dial tone channel used), dialed digits, coin and 2-party information to the marker. The calling CM determines, from the translation of the dialed number and other input information received from the OR, the intermarker group route and operates the route relay.

On an intermarker group call the completing marker input and code translation in the calling marker group are almost identical to the input and translation functions on an outgoing call. See SCD-C1 and SFD-C1 for a description of the completing marker input and code translation operation.

SECTION F, PART 2

SELECTION AND CONTROL OF INTERMARKER GROUP SENDER

Index

		<u>PAGE</u>
F2	SELECTION AND CONTROL OF INTERMARKER GROUP SENDER	F2-2
F2-1	IDLE SENDER TEST (SFD-F204)	F2-2
F2-2	SENDER SUBGROUP SELECTION (SFD-F205)	F2-2
F2-3	SENDER SELECTION (SFD-F206)	F2-3
F2-4	CONNECTION OF SENDER TO A TRUNK (SFD-F206)	F2-3
F2-4.1	OPERATION OF THE OSL SELECT MAGNET (SFD-F206)	F2-3
F2-4.2	OPERATION OF THE OSL HOLD MAGNET (SFD-F206)	F2-3
F2-5	OPERATION OF INDIVIDUAL AND COMMON CHANNELS (SFD-F207)	F2-4
F2-6	TRUNK LINK FRAME REGISTRATION FOR CALLED MARKER GROUP (SFD-F208,F209)	F2-5
F2-7	CALLED NUMBER TRANSFER TO INTERMARKER GROUP SENDER AND DIGIT CHECK (SFD-F210,F211)	F2-10
F2-8	MARKER AMA INPUTS TO THE SENDER (SFD-F212-F214)	F2-10
F2-9	SENDER REGISTRATION TIMING (SFD-F215)	F2-10
F2-10	SENDER ADVANCE (SFD-F206)	F2-11

F2 SELECTION AND CONTROL OF INTERMARKER GROUP SENDER

The calling marker group is required to supply information to the called marker group. Intermarker group senders store the calling information received from the calling completing marker and pass this information to the completing marker in the called marker group. The calling CM determines that an intermarker group sender is needed and then selects and connects to a sender through the outsender connector. The calling marker then passes the called digits and, if AMA is required, additional information to the sender. The completing marker performs many functions at the same time. Two functions performed at approximately the same time are sender and trunk functions. After the marker selects a trunk, and the F0 relay operates (part F3), the calling marker closes a path from the sender to the trunk through the outgoing sender link frame. The sender is now attached to the trunk, and the trunk link on which the IMG trunk appears in the called marker group is stored in the intermarker group sender.

F2-1 IDLE SENDER TEST (SFD-F204)

When the route selected requires a sender, the marker grounds its OS-punching through the operated route relay. The OS-punching is cross-connected to an OSG-punching to select an outsender group. Operation of the OSGO-11, outsender group, relay operates marker off-normal relays, OGC, OSC, and SON. These relays prime the marker to work with the sender. The operation of the OSG-relay extends test leads from the marker to the selected group of senders to determine which subgroup within the selected group has idle senders. Ground on the SIE, sender idle eve, (for even numbered markers) or ground on SIO, sender idle odd (for odd numbered markers) from subgroup A or B will operate SIA and/or SIB relays depending on whether one or both sender subgroups have idle senders.

F2-2 SENDER SUBGROUP SELECTION (SFD-F205)

It is necessary to determine if the outsender connector associated with subgroup A or B is busy. The OSG-relay extends the GBE, group busy even (for even numbered markers) and GBO, group busy odd (for odd numbered markers) leads from the outsender connector to the marker. The presence of ground on either lead indicates the connector is busy. This ground also operates GBA or GBB relays. The operation of the SIA or SIB relay or the GBA or GBB directs the marker to seize one of two connectors. The OSC, outsender connector, is seized when the marker extends battery over the start lead to operate the MP-, marker preference, relay in the OSC preference control circuit. To check that the MP-relay operates, ground is extended through the MP-relay to the completing marker to operate the SKA or SKB, sender connector check subgroup A/B.

F2-3 SENDER SELECTION (SFD-F206)

The operation of the SKA or SKB operates the OSGA or OSGB relay in the OSC associated with the selected subgroup. The operation of the OSGA or OSGB relay extends the OSO-4 leads from the marker to the selected sender. Ground on any of the OSO-4 leads indicate an idle sender and operates the associated OS- relay(s). If more than one OS- relay operates, the setting of the marker junctor sequence circuit will determine which sender is preferred. The operation of one or more OS- relays operates the OSE and OSE1, outsender end relays. The operation of the OSE relay indicates that the sender has been seized. After the sender is selected, the OSE1 relay tests the OS- lead to check that the OS- relay was not operated falsely. When the SB (sender busy) relay operates, ground from the sender is removed and the OSE1 should release. If more than one OS- relay is operated (indicating more than one sender is available) the preferred OS- is locked operated and all others released.

F2-4 CONNECTION OF SENDER TO A TRUNK (SFD-F206)

The marker connects the sender to the outgoing trunk through the cross-bar switches in the OSL, outgoing sender link frame. The senders are connected to the horizontals of the crossbar switch and the outgoing trunks connected to the verticals. The OSL select magnet is operated when the sender is selected and the trunk link is seized. The operation of the hold magnet must wait until the outgoing trunk connection is complete. The completing marker is performing many functions as it connects to the sender. The selection of the trunk link and trunk coincide with the sender functions, even though these functions are described later in the SCD.

F2-4.1 OPERATION OF THE OSL SELECT MAGNET (SFD-F206)

The operation of the SKA or SKB relay operates the SSA or SSB relay. Contacts of these relays close the ten select magnet leads either to the XSS relay or to the OSO-4 relays. With the nonpreferred OS- relays released and the SSA or SSB relay operated, the OSL select magnet SS- associated with the selected sender operates.

F2-4.2 OPERATION OF THE OSL HOLD MAGNET (SFD-F206)

After the SS- select magnet operates, battery is extended from the winding of the OSL hold magnet, through the make-contact of the trunk FO relay, through the off-normal contact of the OSL select magnet to the winding of the high resistance polar relay SHK, sender link hold check. The high resistance winding of the SHK relay prevents the SH hold magnet from operating, but tests the lead by operating the SHK. The operation of the SHK operates the SHKA (sender link hold check auxiliary) relay.

If the dual voltage method of operating the OSL hold magnet is used, the operation is as follows. When the SON relay operates prior to the operation of the SHKA relay, the SH1,2 capacitors are charged to +130 volts with respect to ground. The operation of the SHKA relay isolates the +130 volt charging source and completes the circuit through the SH1, 2 capacitors, the SLK (sender link check) relay, and the SH- hold magnet. The SH1,2 capacitors discharge through the primary winding of the SLK relay to ground, through the -48 volt battery source, through the SH- hold magnet, to the side of the SH1,2 capacitors. This applies 178 volts to the circuit, the +130 charge in series with the -48 volts on the hold magnet, to cause fast operation of the SH- hold magnet. The current flowing through the SLK relay primary winding overcomes the bias and operates the SLK relay. When the charge in the SH1,2 capacitors discharges to the level that -1/2 volt is standing on the SH diode with respect to ground, the SH diode is forward biased to allow steady current to hold the SH- hold magnet and the SLK relay operated. The operation of the SLK relay operates the SLK1 (sender link check auxiliary) relay to indicate that OSL crosspoints should be closed. The ground holding the OSL hold magnet operated extends through the OSL crosspoints to operate the sender ON (off-normal) relay. The ON relay operates the SR relay in the intermarker group sender. About the same time, the trunk supervisory S1 relay grounds the AB lead to the sender operating the line release relay LR and then the T, R, or D relay. The operation of sender relays ON, LR and one of the relays T, R, or D connects ground to lead HM to hold the sender link hold magnet and shunt the marker SLK relay. The release of the SLK operates the marker SLK2 relay which indicates control of the OSL has been turned over to the sender and the OSL crosspoints are closed.

F2-5 OPERATION OF THE INDIVIDUAL AND COMMON CHANNELS (SFD-F207)

The operation of the OSKA (outsender check auxiliary) relay and the preferred OS- relay in the marker operates the S- relay in the OSC to establish an individual channel between a particular marker and a particular sender. This individual channel relay is used to operate the sender part of the common channel, to pass AMA recorder number class and advance reorder information between the marker and the sender. It is necessary to pass this information through the S- relay because the common channel releases early to free the OSC for use on other calls.

The common channel consists of two parts, the marker part and the sender part. The relays are multicontact relays designated MA1-2, MB1-2 and MC1-2 for the marker part, and SA1-2, SB1-2 and SC1-2 for the sender part. The physical location of the MA-, MB-, MC- relays is on the OSC frame. The physical location of the SA-, SB-, SC- relays is on the sender frame.

F2-6 TRUNK LINK FRAME REGISTRATION FOR CALLED MARKER GROUP
(SFD-F208, F209)

In order to complete the intermarker group call, the completing marker in the called marker group must know what trunk link frame to seize to find the intermarker group trunk. The trunk link frame number in the called marker group is passed from the intermarker group trunk to the intermarker group sender via the outsender link over leads T, R, and D. One of these leads is always connected to ground through the low resistance F1 relay in the trunk and the other two are connected to either very high resistance, high resistance, or low resistance battery in the intermarker group trunk. Combinations of these connections are used to represent the possible trunk link frame number in the called marker group. The following tables indicate the cross connections in the IMG trunk used to operate the proper relays in the intermarker group sender which pass the TLF number to the marker in the called marker group:

IMG TRUNK CROSS CONNECTIONS -
 20 TLF CALLED MARKER GROUP

Trunk Link Frame	Terminals		
	72	73	74
00	63		62
01	63		52
02	62	52	63
03	62		63
04	62	52	
05	62		
06	62		52
07	63		
08	62	63	
09	62	63	52
10	63	52	62
11	63	62	52
12	52	62	63
13	52		63
14	52	62	
15	52		
16	52		62
17	63	52	
18	52	63	
19	52	63	62

IMG TRUNK CROSS CONNECTIONS -
30 TLF CALLED MARKER GROUP

Trunk Link Frame	Terminals			
	65	72	73	75
00		62	63	
01		62	52	63
02	52	62		63
03		62		
04	52	62	63	
05		62	52	
06	52	62		
07	63	62	52	
08	63	62		
09		62		63
10		52	63	
11		52	62	63
12	62	52		63
13		52		
14	62	52	63	
15		52	62	
16	62	52		
17	63	52	62	
18	63	52		
19		52		63
20		63	52	
21		63	62	52
22	62	63		52
23		63		
24	62	63	52	
25		63	62	
26	62	63		
27	52	63	62	
28	52	63		
29		63		52

After the LR relay in the sender operates, the T, R, and D relay windings are connected through to the trunk. One of these relays will operate to ground in the trunk, but the low resistance trunk relay F1 which is in series will not operate at this time. The operated T, R, or D opens a holding circuit for the SR relay, but the SR relay will not release until the marker IMG relay releases. When the SR relay does release the start lead for the called marker is extended to the make contacts of the AV relay in the sender (SFD-F504/F1).

The operation of the T, R, or D also disconnects leads T, R, and D from the windings of the corresponding relays and transfers them as follows. The grounded lead is connected to the "F lead" through the IRMC and is used later by the CM in the called marker group for operating the F1 relay in the trunk. The other two leads are connected to relays which test for a very high resistance, high resistance, low resistance battery, or open circuit condition. The TMG tip marginal and TS tip sensitive relays are connected to lead T or R and the RMG ring marginal, RS ring sensitive and RVS ring very sensitive relays to lead R or D. A lead connected to low resistance battery (210 ohms) will operate all testing relays. A lead connected to high resistance battery (1300 or 1670 ohms) will operate the sensitive and very sensitive relay. A lead connected to very high resistance battery (7500 ohms) will operate only the very sensitive relay. An open lead will operate no relays.

Any combinations of relays T, R, D, TMG, TS, RMG, RS, and RVS which may operate will ground leads through the IRMC to the CM in the calling marker group to indicate the TLF number of the IMG trunk. Five leads TFO, 1, 2, 4 and 7 are grounded two at a time to indicate the units digit of the TLF number and lead FGO-2 is grounded to indicate the tens digit. The following tables indicate, for any frame number, proper connections to leads T, R, and D in the IMG trunk, what IMG sender relays operate, and what leads are grounded toward the called marker (SFD-F416, F417).

20 TLF CALLED MARKER GROUP. PROPER POTENTIAL CONNECTIONS TO
T, R, OR D LEADS IN IMG TRUNK, IMG SENDER RELAYS OPERATED AND
LEADS GROUNDED TOWARD MARKER

Trunk Link Frame	Connections to IMG Trk Leads			IMG Sender Relays Operated					Leads Grounded Toward Marker	
	T	R	D	T,R, or D	TS	TMG	RS	RMG	FG	TF
00	HRB	-	G	D	X				0	4,7
01	-	HRB	G	D			X		0	0,1
02	G	LRB	HRB	T	X	X	X		0	0,2
03	G	-	HRB	T			X		0	1,2
04	G	LRB	-	T	X	X			0	0,4
05	G	-	-	T					0	1,4
06	G	HRB	-	T	X				0	2,4
07	-	-	G	D					0	0,7
08	G	-	LRB	T			X	X	0	1,7
09	G	HRB	LRB	T	X		X	X	0	2,7
10	HRB	LRB	G	D	X		X	X	1	4,7
11	LRB	HRB	G	D	X	X	X		1	0,1
12	LRB	G	HRB	R	X	X	X		1	0,2
13	-	G	HRB	R			X		1	1,2
14	LRB	G	-	R	X	X			1	0,4
15	-	G	-	R					1	1,4
16	HRB	G	-	R	X				1	2,4
17	-	LRB	G	D			X	X	1	0,7
18	-	G	LRB	R			X	X	1	1,7
19	HRB	G	LRB	R	X		X	X	1	2,7

HRB means high-resistance battery - 1260 or 1300 ohms

LRB means low-resistance battery - 210 ohms

G means ground through low-resistance relay winding

30 TLF CALLED MARKER GROUP. PROPER POTENTIAL CONNECTIONS TO
T, R, OR D LEADS IN IMG TRUNK, IMG SENDER RELAYS OPERATED AND
LEADS GROUNDED TOWARD MARKER

Trunk Link Frame	Connections to IMG Trk Leads			IMG Sender Relays Operated						Leads Grounded Toward Marker	
	T	R	D	T,R, or D	TMG	TS	RMG	RS	RVS	FG	TF
00	G	-	LRB	T			X	X	X	0	4,7
01	G	LRB	VHRB	T	X	X			X	0	0,1
02	G	HRB	VHRB	T		X			X	0	0,2
03	G	-	-	T						0	1,2
04	G	HRB	LRB	T		X	X	X	X	0	0,4
05	G	LRB	-	T	X	X				0	1,4
06	G	HRB	-	T		X				0	2,4
07	G	LRB	HRB	T	X	X		X	X	0	0,7
08	G	-	HRB	T				X	X	0	1,7
09	G	-	VHRB	T					X	0	2,7
10	-	G	LRB	R			X	X	X	1	4,7
11	LRB	G	VHRB	R	X	X			X	1	0,1
12	HRB	G	VHRB	R		X			X	1	0,2
13	-	G	-	R						1	1,2
14	HRB	G	LRB	R		X	X	X	X	1	0,4
15	LRB	G	-	R	X	X				1	1,4
16	HRB	G	-	R		X				1	2,4
17	LRB	G	HRB	R	X	X		X	X	1	0,7
18	-	G	HRB	R				X	X	1	1,7
19	-	G	VHRB	R					X	1	2,7
20	-	LRB	G	D			X	X	X	2	4,7
21	LRB	VHRB	G	D	X	X			X	2	0,1
22	HRB	VHRB	G	D		X			X	2	0,2
23	-	-	G	D						2	1,2
24	HRB	LRB	G	D		X	X	X	X	2	0,4
25	LRB	-	G	D	X	X				2	1,4
26	HRB	-	G	D		X				2	2,4
27	LRB	HRB	G	D	X	X		X	X	2	0,7
28	-	HRB	G	D				X	X	2	1,7
29	-	VHRB	G	D					X	2	2,7

LRB means low-resistance battery - 210 ohms

HRB means high-resistance battery - 1670 ohms

VHRB means very high-resistance battery - 7500 ohms

G means ground through a low-resistance relay winding

F2-7 CALLED NUMBER TRANSFER TO INTERMARKER GROUP SENDER AND DIGIT CHECK (SFD-F210, F211)

The marker OGC relay operating operates the KG (called number digit cut-in ground) relay. This relay operates the KA, KBC, KDE, KFG, and KHJ (cut-in for A, B, and C digits, etc.) relays. These cut-in relays cut through ground from the OR to the A 2/5-H7 leads which operate the A 2/5-H7 relays in the calling completing marker and intermarker group sender. The operation of the ORK1 and ORK2 (outgoing registration check) relays indicate that the proper number of A 2/5-H7 relays in the marker have operated. If the ORK1, ORK2 relays remain operated (ORK punch) after the digit cut-in relays have released, the digit relays in the sender locked operated.

F2-8 MARKER AMA INPUTS TO THE SENDER (SFD-F212-F214)

On an AMA call the calling marker transmits AMA information to the sender which is sent to the transverter and then fed into the AMA recorder. The marker TGS2 relay, which operates only on AMA calls, provides ground for the intermarker group sender AMA relays through previously operated marker relays. The TGS2 also operates the marker check relays which, after the TGS2 releases, are held operated by ground from the operated sender relays. If the marker check relays fail to remain operated, the CM will stop its progress at the RSC relay, time out, and deliver a trouble record.

F2-9 SENDER REGISTRATION TIMING (SFD-F215)

The purpose of the OST timing interval is to allow sufficient time for the intermarker group sender registration relays to operate. The sender registration timing is started when the outgoing sender connector relays operate and ground is extended over the "TSR" lead. On non-AMA calls, ground is extended through the OSC multicontact relays, through the KK, TGS1, ORK1, ORK2, the OST and OST2 normal to operate the marker OST1 relay. The OST1 locks operated under control of the KK and TGS1 relays. The OST1 operating removes the shunt from the OST relay allowing the OST capacitor to start charging. When the OST capacitor is fully charged, the bias on the secondary winding is removed operating the OST relay. The OST operating transfers the "TSR" lead ground through its make-contacts and operates the OST2 relay in the marker. The OST2 operating releases the TGS1, KG and other relays. After the KK and TGS1 release the OST1 relay releases. The OST1 releasing extends ground from the OST2 operated (SFD-F215/F3), through the sender check relays operated to operate the marker RSC (release sender connector) relay.

F2-10 SENDER ADVANCE (SFD-F206)

After the marker has checked that the connection has been established, as indicated by the operation of the DCT and the GT1 relays, and that all the sender information has been transferred satisfactorily (as indicated by the operation of the RSC relay) an advance signal is given to the sender. The marker operates the AV advance relay in the sender (SFD-F206). If the call is AMA, it is necessary to also check that the recorder number information has been checked by the RNK1,2 relays.

The sender AV relay operates in series with the primary winding of the marker AVK relay and the AVK1 resistor. The operate current for the AV relay flows in the direction to hold the AVK relay nonoperated. The AV relay in the sender is operated just before the marker disconnects from the connection, after determining that all checks are satisfactory.

After the AV relay has operated, it locks to ground in the sender. This locking ground is extended to the marker over the AV lead from the OSC. The AV lead is through the individual channel (S relay part of the OSC) as the common channel has been released. This locking ground is extended to the primary winding of the AVK relay and causes current to flow in a direction to operate the relay. The operation of the AVK relay indicates that the intermarker group sender AV relay is locked operated.

After operating, the AVK relay operates the AVK1 advance check auxiliary relay. The operation of the AVK1 relay causes the marker to perform linkage checks and then to disconnect.

SECTION F, PART 3

CONNECTION TO THE TRUNK LINK, LINE LINK AND NETWORK
CONNECTION - CALLING MARKER GROUP

Index

	<u>PAGE</u>
F3 CONNECTION TO THE TRUNK LINK, LINE LINK AND NETWORK CONNECTION - CALLING MARKER GROUP	F3-2

F3 CONNECTION TO THE TRUNK LINK, LINE LINK AND NETWORK CONNECTION -
CALLING MARKER GROUP

While the intermarker group sender connection is being established (Part F2), the completing marker proceeds to select a trunk link frame having an idle trunk of the correct type. The calling completing marker then selects and connects to the intermarker group trunk through the TLC (trunk link connector) frame.

Following trunk link frame seizure, the line link frame on which the calling line is located is seized. This gives the CM access to, and control of, the calling line select and hold magnets.

Once the trunk and line link seizure is completed a connection between the line and trunk are made by closing the line switch and junctor switch crosspoints on the LL, and the junctor switch and trunk switch crosspoints on the TL. The select magnets and hold magnets involved in closing the specific crosspoints depend on the location of the line on the line switch, the trunk on the trunk switch, and the channel selected. After crosspoints are closed, the channel is checked for crosses, continuity and double connections.

On an intermarker group call the trunk link, line link and network connection in the calling marker group are almost identical to the same operations performed on an outgoing call. See SFD and SCD Sections C3, C4 and C5 for a description of the trunk link, line link and network connections in the calling marker group.

SECTION F, PART 4

CALLING COMPLETING MARKER RELEASE, INTERMARKER GROUP
SENDER STORAGE AND CONTROL

Index

	<u>PAGE</u>
F4 CALLING COMPLETING MARKER RELEASE, INTERMARKER GROUP SENDER STORAGE AND CONTROL	F4-2
F4-1 COMPLETING MARKER RELEASE	F4-2
F4-1.1 MARKER NORMAL RELEASE - OPERATION OF THE DIS1,2 RELAYS (SFD-F405)	F4-2
F4-1.1.1 Trouble Record - Operation of the TRR Relay (SFD-F405)	F4-2
F4-1.2 MARKER TROUBLE RELEASE - OPERATION OF THE TRL RELAY (SFD-F405)	F4-3
F4-1.2.1 Line Link Frame Make Busy (SFD-F405)	F4-3
F4-1.2.2 Trouble Record - Operation of the TR1 Relay (SFD-F405)	F4-3
F4-1.3 MARKER OVERALL TIME-OUT RELEASE - OPERATION OF THE MRL, MRL1 RELAYS (SFD-C137)	F4-4
F4-1.4 CONTROL OF MARKER RELEASE BY THE MASTER TEST CONTROL CIRCUIT (SFD-F404,F405)	F4-4
F4-1.4.1 Requesting Trouble Record Using MTC Circuit - Operation of the REC Relay (SFD-F405)	F4-5
F4-1.5 TROUBLE RECORDER REQUESTS (SFD-F407)	F4-5
F4-1.5.1 Trouble Recorder Busy (SFD-F407)	F4-5
F4-2 INTERMARKER GROUP SENDER OPERATION	F4-6
F4-2.1 IMG SENDER - DIGIT REGISTRATION AND INPUT TO CALLED COMPLETING MARKER (SFD-F410)	F4-6
F4-2.2 IMG SENDER CONTROL (SFD-F411)	F4-6
F4-2.3 INTERMARKER GROUP SENDER TIMING (SFD-F413)	F4-7
F4-2.4 TRUNK LINK FRAME IDENTIFICATION CALLED MARKER GROUP (SFD-F414-F417)	F4-8

F4 CALLING COMPLETING MARKER RELEASE, INTERMARKER GROUP SENDER STORAGE AND CONTROL

Upon the successful completion of the double connection test and the ground test, the completing marker transmits an advance signal to the intermarker group sender. The calling completing marker then checks the functions in the sender, that linkage is properly set up, and releases.

Once the intermarker group sender is connected to the calling CM, control relays operate in the sender, and the called digits and TLF number of the intermarker group trunk in the called marker group are stored in the IMG sender for later passage to the CM in the called marker group. After the connection in the called marker group is established the called CM releases which releases the intermarker group sender.

F4-1 COMPLETING MARKER RELEASE

The marker may encounter numerous conditions that require disconnect, and when these conditions occur the marker has various methods of disconnection.

F4-1.1 MARKER NORMAL RELEASE - OPERATION OF THE DIS1,2 RELAYS (SFD-F405)

When the marker has completed all functions successfully without encountering any trouble, the LK1 (linkage check) relay will operate causing the DIS1,2 (disconnect) relays in the CM to operate.

The DIS1,2 relays operating, release the CKG1,2 relays in the CM and ground the MRL lead into the OR (originating register) to operate the MRL relay (SFD-C107). The MRL relay operating, releases the MS- relay in the ORMC, and by opening the start lead into the connector prevents a second trial (SFD-C104).

F4-1.1.1 Trouble Record - Operation of the TRR Relay (SFD-F405)

There are conditions whereby the CM detects trouble and, before releasing, takes a trouble record by operating the TRR (trouble record regular) release relay. These conditions are as follows:

When the marker receives a permanent signal indication from the OR, the PS relay in the CM operates. If the APS (all permanent signal) key is operated at the JLK bay, the PSR relay in the CM operates. The PSR and PS relays operate the TRR relay in the CM and a trouble record is taken. The permanent signal trouble record is used to obtain the line information.

When the start lead is shifted to an alternate marker in the ORMC due to a delay in the selection of a marker, the TRS (transfer start) relay in the PC circuit operates. After the alternate marker is selected, the

TRS relay in the CM operates. The TRS relay operates the TRR relay and a trouble record is taken. The TRS trouble record is used to identify the connector used on the call.

A time out or cross failure will cause the CM to take a trouble record. If the marker usage is a first trial (TR2C relay normal) and the dialing connection has released (CB5, CHA, and TK relays operated), the TRR relay in the CM operates and a trouble record is taken. A second trial is not possible on this type of call because the OR has already released.

When the trouble record is completed, the DIS1,2 relays in the CM operate from the operated TRR, TRB1, RDL, and TRSA relays. The marker then releases on a normal basis.

F4-1.2 MARKER TROUBLE RELEASE - OPERATION OF THE TRL RELAY (SFD-F405)

If the CM encounters trouble while trying to complete the call, the TRL (trouble release) relay in the marker will operate. The TRL relay operating releases the CKC1,2 relays in the CM and grounds the TRL lead into the PC (preference control circuit) operating the TRL relay (SFD-C107). The TRL relay operating releases the MS- (marker start) relay in the ORMC. The Z relay in the PC changing condition shifts the ST (start lead) to the alternate marker and a second attempt is made to complete the call (SFD-C104). A trouble release permits a second trial providing the MRL or BT relays in the OR (originating register) are normal.

F4-1.2.1 Line Link Frame Make Busy (SFD-F405)

When a plug is inserted into the LMB jack at the LLF, the MB relay operates in the PC circuit. The MJ relay in the JLK circuit then operates and a major alarm is sounded.

As a result of the MB relay operating, the LLB relay in the marker (SFD-C405) operates and removes battery from the start lead. The LLB relay operates the RBT relay which operates the RDL and then the TRL which releases the marker on a trouble basis.

F4-1.2.2 Trouble Record - Operation of the TR1 Relay (SFD-F405)

There are conditions whereby the CM detects trouble and, before releasing, takes a trouble record by operating the trouble record-trouble release TR1 relay. These conditions are as follows.

A time out or cross failure will cause the CM to take a trouble record. If the marker usage is a first trial (TR2C relay normal) and the dialing connection has not released (CB5, CHA, or TK relays normal), the TR1 relay in the CM operates and a trouble record is taken. A second trial is possible on this type of call because the OR is still attached to the

circuit. If the marker usage is a second trial, TR2C relay operated, the TR1 relay in the CM operates and a trouble record is taken. Since the marker usage is a second trial, the BT relay in the OR will operate opening the start lead preventing another attempt to complete the call.

When the trouble record is completed, the TRL relay in the CM operates from the operated TR1, TRB1, RDL, and TRSA relays. The marker then releases on a trouble basis.

F4-1.3 MARKER OVERALL TIME-OUT RELEASE - OPERATION OF THE MRL, MRL1 RELAYS (SFD-C137)

If the called marker fails to complete its stage of the call within the allotted interval of 9.6 to 15.4 seconds, the OAT timer functions and causes the MRL (marker release) relay to operate. The MRL relay operates the MRL1 relay (SFD-F405), which operates the busy test BT and MRL relays in the OR (SFD-C107). The MRL relay operating releases the MS-relay in the ORMC and by opening the start lead into the connector prevents a second trial (SFD-C104).

On this type of release, a trouble record is not taken but the TA (timing alarm) lamp will be lighted on the marker frame.

F4-1.4 CONTROL OF MARKER RELEASE BY THE MASTER TEST CONTROL CIRCUIT (SFD-F404, F405)

On test calls certain MT- (marker test) relays operate in the CM. These test relays operating allow the MTC circuit to interact with the marker.

With the MT17 relay operated in the CM, the DCT1 relay operating path is extended into the MTC circuit over the TDCT lead. The DCT1 relay operating ground is extended over the DCT lead into the MTC circuit to operate the DCT relay. With the REC key normal, the operation of the DCT relay in the MTC circuit operates the M01 relay. The M01 relay in the MTC circuit operating connects ground to the TDCT lead into the CM, operating the DCT1 relay. The CM then continues its progress on a normal basis.

With the MT1 relay operated in the CM, the DIS1,2 relays operating path is extended into the MTC circuit over the DIS lead. After the LK1 (linkage check) relay in the CM operates, ground is extended over the LK2 lead into the MTC circuit. The LK2 relay in the MTC operates, lighting the LK2 lamp. Ground is now transmitted over the LK3 lead through the CM and back into the MTC on the DIS1 lead. The DIS1,2 relays in the MTC circuit operate, lighting the DIS1 lamp, and ground is extended over the DIS lead into the CM operating the DIS1,2 relays. The CM then gives a normal release. It may be noted that if the LK2 and DIS1 lamp at the MTC panel are both lighted, the marker has completed setting up the connection and released.

F4-1.4.1 Requesting Trouble Record Using MTC Circuit - Operation of the REC Relay (SFD-F405)

When it is desired to obtain a record of the progress of the CM when making a test call, the REC key (record request) should be operated at the MTC panel. The REC key operates the REC relay in the MTC after the DCT relay has operated. Thus, the REC relay is operated prior to the completing marker DCT1 relay. The REC relay operated extends ground into the CM over the TRR lead to operate the TRR relay. The TRR relay operates the TRST (trouble recorder start) relay in the CM which operates the MPR- marker preference relay in the MTFC to request a trouble record. A trouble record is taken and the CM releases on a normal basis. These trouble records requested by the test equipment can be distinguished from service or legitimate trouble records by the absence of the TI (trouble indication) punch on the trouble record card.

F4-1.5 TROUBLE RECORDER REQUESTS (SFD-F407)

When the marker encounters a trouble condition, the TRR or TR1 relay will operate in the CM and cause the trouble recorder to be seized by the trouble recorder start relay operating (SFD-F405). The TRST operates the TRSA relay in the marker. On first trial calls, the MN relay in the JLK circuit operates and a minor alarm is sounded. On second trial calls, the MJ relay in the JLK circuit operates and a major alarm is sounded. The marker preference MPR- relay in the MTFC circuit is then operated (SFD-F407) from battery on the TRST lead. The MPR- relay connects ground to the CI lead which operates the MKA, MKB, and MKB1 relays in the MTFC. The MKA relay operates the MTR (marker test repeat) relay which operates the CIC (cut-in connector) relay in the MTFC (SFD-F407) and a trouble record is taken.

After the trouble record is complete, ground over the TRC lead from the TRC (trouble recorder control) circuit operates the TRC and TRC1 (trouble record complete) relays in the MTFC. The RM (release marker) relay in the MTFC operates and ground is transmitted over the TRB lead into the CM to operate the TRB1,2 (trouble recorder busy) relays. The TRB1 relay operating removes battery from the TRST lead releasing the MPR- and MKA relays in the MTFC. The TRB2 relay operates the RDI (release delay) relay in the marker. The marker will then release on a normal or trouble basis.

F4-1.5.1 Trouble Recorder Busy (SFD-F407)

When a trouble record is requested by the marker with the operation of the TRR or TR1 relays and there is a previous trouble record in progress with the TRB1 relay operated, the DL (display lost) relay in the marker will operate. The DL relay operating will cause the DL- lamp in the JLK circuit to light, indicating the loss of a trouble record. The marker will then release on a normal or trouble basis.

F4-2 INTERMARKER GROUP SENDER OPERATION

Once the intermarker group sender is connected to the calling CM, control relays operate in the sender and the called digits and TLF number of the intermarker group trunk in the called marker group are stored in the IMG sender for later passage to the CM in the called marker group. After the connection in the called marker group is established the called CM releases which releases the intermarker group sender.

F4-2.1 IMG SENDER-DIGIT REGISTRATION AND INPUT TO CALLED COMPLETING MARKER (SFD-F410)

The IMG sender is equipped to handle up to eleven digits, as recorded in the originating register. The called digits are registered in the sender on relays A-L. Since the SFD document is covering only subscriber to subscriber IMG calls, the A-H are the only digit registration relays shown. The completing marker operates these registration relays on a 2-out-of-5 basis from ground through the OSC circuit.

Since the number of digits an intermarker group sender receives on different calls may vary, an indication is needed to make the end-of-digit registration. This is the end-seven registration and consists of operating only the seven digit register relay, one beyond the last registered digit. The completing marker is able to detect missing digits since the registration must consist of 2-out-of-5 in each position up to the end-seven which is followed by a 0-out-of-5. Should any of the digit registration relays in the sender fail to lock operated, the ORK1,2 (outgoing registration check) relays in the completing marker will not operate and the punch indication A'(2/5)-H'7 will be missing from the trouble record card.

After the digit registration relays have locked operated in the sender and once the CM in the called marker group has been seized the called digits are passed to the called CM.

F4-2.2 IMG SENDER CONTROL (SFD-F411)

After the calling CM has selected an idle IMG trunk that has access to an idle IMG sender, the marker connects to the sender via the OSC, the trunk via the TLC and establishes a connection between the sender and trunk via the OSL. Once the marker is connected to the sender, ground is extended from the marker to the sender on the ON1 lead to operate the ON1 relay. The ON1 operates the sender-busy SB relay. After the sender is connected to the trunk by closure of the OSL crosspoints, the SH ground in the marker extends through the TLC and OSL crosspoints to operate the sender ON (off normal) relay. The ON relay operates the SR relay in the sender through the normal T, R, and D relays. About the same time, the trunk supervisory S1 relay grounds the AB lead to the sender operating the line release LR and then the T, R, or D relay.

After the calling marker has checked that the connection has been established, as indicated by the operation of the DCT and GT1 relays, and that all the marker information has been transferred satisfactorily to the sender (as indicated by the operation of the RSC relay) an advance signal is given to the sender. The marker passes ground over the AV lead toward the sender operating the AV relay.

The sender control relays are held operated by the ON relay. The ON will release after the LR which releases when the sender MRL relay operates once the called marker disconnects.

F4-2.3 INTERMARKER GROUP SENDER TIMING (SFD-F413)

The intermarker group sender TM timer measures for interval between the seizure and release of the sender. If the sender operation is not completed within the allowable interval of 13-25 seconds, the TM timer functions and operates the TM relay in the intermarker group sender.

The TM relay grounds the "LP lead" into the JLK circuit (calling MG), lighting the TO lamp, grounds the "ALM lead" into the JLK circuit to start the office timer, and operates the RO (reorder) relay in the sender. The RO relay locks operated and opens the operating circuit for the TM relay which then releases removing the grounds from the LP and ALM leads. The RO relay operating also changes the class signal to the marker in the called marker group to reorder, (SFD-F508/D9), and closes a circuit for discharging the TM capacitor. With the TM relay normal and the RO relay operated, a circuit is prepared for operating the TML relay in the sender. The TML relay is made slow in operating to provide time for deionizing the TM-tube and discharging the TM capacitor. The TML relay locks operated and again starts the TM timer. After the CM in the called marker group disconnects the sender MRL relay operates. The MRL operating releases the LR relay which releases the ON followed by other operated relays in the sender.

If for some reason the CM in the called MG does not send a release signal to the sender within 13-25 seconds after the TML relay operates, the TM timing circuit will again function operating the TM relay in the sender. The TM relay grounds the "LP lead" into the JLK (calling MG), lighting the TO lamp, and grounds the "ALM" lead into the JLK to start the office timer. With the TM and TML relays operated the MTRL relay operates (SFD-F507/C8) which releases the LR relay in the sender. If the CTR (cancel timed release) key on the JLK bay is normal (pushed in) the release of the LR relay will cause the release of the ON relay followed by other operated relays in the sender. The TM relay will release from the ON1 and remove grounds from the "LP" and "ALM" leads into the JLK circuit. If the CTR key is operated (pulled out) the ON relay will be held operated through the TM contacts (SFD-F411/G73) maintaining the ground on leads LP and ALM.

After a timed interval the ALM ground into the JLK will cause the major alarm to operate with the register sender time-out alarm (RST-OA) indication. If the sender MB relay is operated by the insertion of a plug in the MB jack at the JLK bay, the ground is removed from the ALM lead which retires the major alarm leaving the TO lamp lighted. When the CTR key is restored to normal (pushed in), the ON relay will release, allowing the release of the operated relays in the sender. When the ON1 relay releases, the TM relay releases and extinguishes the TO lamp.

F4-2.4 TRUNK LINK FRAME IDENTIFICATION CALLED MARKER GROUP (SFD-F414-F417)

In order to complete the intermarker group call, the completing marker in the called marker group must know what trunk link frame to seize to find the intermarker group trunk. The trunk link frame number in the called marker group is passed from the intermarker group trunk to the intermarker group sender via the outsender link over leads T, R, and D. One of these leads is always connected to ground through the low resistance F1 relay in the trunk and the other two are connected to either very high resistance, high resistance, or low resistance battery in the intermarker group trunk. Combinations of these connections are used to represent all possible trunk link frame numbers in the called marker group. The following tables indicate the cross connections in the IMG trunk used to operate the proper relays in the intermarker group sender which pass the TLF number to the marker in the called marker group:

IMG TRUNK CROSS CONNECTIONS -
20 TLF CALLED MARKER GROUP

Trunk Link Frame	Terminals		
	72	73	74
00	63		62
01	63		52
02	62	52	63
03	62		63
04	62	52	
05	62		
06	62		52
07	63		
08	62	63	
09	62	63	52
10	63	52	62
11	63	62	52
12	52	62	63
13	52		63
14	52	62	
15	52		
16	52		62
17	63	52	
18	52	63	
19	52	63	62

IMG TRUNK CROSS CONNECTIONS -
30 TLF CALLED MARKER GROUP

Trunk Link Frame	Terminals			
	65	72	73	75
00		62	63	
01		62	52	63
02	52	62		63
03		62		
04	52	62	63	
05		62	52	
06	52	62		
07	63	62	52	
08	63	62		
09		62		63
10		52	63	
11		52	62	63
12	62	52		63
13		52		
14	62	52	63	
15		52	62	
16	62	52		
17	63	52	62	
18	63	52		
19		52		63
20		63	52	
21		63	62	52
22	62	63		52
23		63		
24	62	63	52	
25		63	62	
26	62	63		
27	52	63	62	
28	52	63		
29		63		52

After the LR relay in the sender operates, the T, R, and D relay windings are connected through to the trunk. One of these relays will operate to ground in the trunk but the low resistance trunk relay F1 which is in series will not operate at this time. The operated T, R, or D opens a holding circuit for the SR relay, but the SR relay will not release until the marker IMG relay releases. When the SR relay does release the start lead for the called marker is extended to the make contacts of the AV relay in the sender (SFD-F504/F1).

The operation of the T, R, or D also disconnects leads T, R, and D from the windings of the corresponding relays and transfers them as follows.

- (a) The grounded lead is connected to the F lead through the IRMC and is used later by the CM in the called marker group for operating the F1 relay in the trunk.
- (b) The other two leads are connected to relays which test for a very high resistance, high resistance, or low resistance battery or open circuit condition.
- (c) The TMG tip marginal and TS tip sensitive relays are connected to lead T or R and the RMG ring marginal, RS ring sensitive and RVS ring very sensitive relays to lead R or D.
- (d) A lead connected to low resistance battery (210 ohms) will operate all testing relays.
- (e) A lead connected to high resistance battery (1300 or 1670 ohms) will operate the sensitive and very sensitive relay.
- (f) A lead connected to very high resistance battery (7500 ohms) will operate only the very sensitive relay.
- (g) An open lead will operate no relays.

Any combinations of relays T, R, D, TMC, TS, RMG, RS, and RVS which may operate will ground leads through the IRMC to the CM in the called marker group to indicate the TLF number of the IMG trunk. Five leads TFO, 1, 2, 4 and 7 are grounded two at a time to indicate the units digit of the TLF number, and lead FGO-2 is grounded to indicate the tens digit. The following tables indicate, for any frame number, proper connections to leads T, R, and D in the IMG trunk, what IMG sender relays operate, and what leads are grounded toward the called marker (SFD-F416,F417).

30 TLF CALLED MARKER GROUP. PROPER POTENTIAL CONNECTIONS TO
T, R, OR D LEADS IN IMG TRUNK, IMG SENDER RELAYS OPERATED AND
LEADS GROUNDED TOWARD MARKER

Trunk Link Frame	Connections to IMG Trk Leads			IMG Sender Relays Operated						Leads Grounded Toward Marker	
	T	R	D	T,R, or D	TMG	TS	RMG	RS	RVS	FG	TF
00	G	-	LRB	T			X	X	X	0	4,7
01	G	LRB	VHRB	T	X	X			X	0	0,1
02	G	HRB	VHRB	T		X			X	0	0,2
03	G	-	-	T						0	1,2
04	G	HRB	LRB	T		X	X	X	X	0	0,4
05	G	LRB	-	T	X	X				0	1,4
06	G	HRB	-	T		X				0	2,4
07	G	LRB	HRB	T	X	X		X	X	0	0,7
08	G	-	HRB	T				X	X	0	1,7
09	G	-	VHRB	T					X	0	2,7
10	-	G	LRB	R			X	X	X	1	4,7
11	LRB	G	VHRB	R	X	X			X	1	0,1
12	HRB	G	VHRB	R		X			X	1	0,2
13	-	G	-	R						1	1,2
14	HRB	G	LRB	R		X	X	X	X	1	0,4
15	LRB	G	-	R	X	X				1	1,4
16	HRB	G	-	R		X				1	2,4
17	LRB	G	HRB	R	X	X		X	X	1	0,7
18	-	G	HRB	R				X	X	1	1,7
19	-	G	VHRB	R					X	1	2,7
20	-	LRB	G	D			X	X	X	2	4,7
21	LRB	VHRB	G	D	X	X			X	2	0,1
22	HRB	VHRB	G	D		X			X	2	0,2
23	-	-	G	D						2	1,2
24	HRB	LRB	G	D		X	X	X	X	2	0,4
25	LRB	-	G	D	X	X				2	1,4
26	HRB	-	G	D		X				2	2,4
27	LRB	HRB	G	D	X	X		X	X	2	0,7
28	-	HRB	G	D				X	X	2	1,7
29	-	VHRB	G	D					X	2	2,7

LRB means low-resistance battery - 210 ohms

HRB means high-resistance battery - 1670 ohms

VHRB means very high-resistance battery - 7500 ohms

G means ground through a low-resistance relay winding

SECTION F, PART 5

SEIZURE OF CALLED COMPLETING MARKER BY
INTERMARKER GROUP SENDER

Index

		<u>PAGE</u>
F5	SEIZURE OF CALLED COMPLETING MARKER BY INTERMARKER GROUP SENDER	F5-2
F5-1	SEIZURE AND INPUT TO CALLED COMPLETING MARKER (SFD-F504, F505)	F5-2
F5-1.1	MARKER CONNECTOR RELAY CHAIN CIRCUITS (SFD-F505)	F5-2
F5-1.2	CB- (MARKER CONNECTOR BUSY) RELAY CHAIN	F5-2
F5-1.3	MS- (MARKER START OR PREFERENCE) RELAY OPERATE CHAIN	F5-2
F5-1.4	MS- RELAY WORK CHAIN	F5-3
F5-1.5	W AND Z RELAY CONTROL FOR TRANSFERRING START LEADS (SFD-F504)	F5-4
F5-2	TIMING FUNCTIONS IN THE PREFERENCE CONTROL CIRCUIT	F5-5
F5-2.1	TRANSFER START TIMER (SFD-F510)	F5-5
F5-2.2	OVERALL TIMER (SFD-F507)	F5-6
F5-3	INFORMATION PASSED FROM THE IRMC TO THE CALLED COMPLETING MARKER	F5-6
F5-3.1	MB, CONNECTOR BUSY (SFD-F506)	F5-7
F5-3.2	TM, OVERALL TIMER (SFD-F506)	F5-7
F5-3.3	TRL, TROUBLE RELEASE (SFD-F507)	F5-7
F5-3.4	BT AND MRL, OVERALL TIME OUT RELEASE (SFD-F507)	F5-7
F5-3.5	ECN/OCN, EVEN-ODD REGISTER CONNECTOR (SFD-F507)	F5-7
F5-3.6	RO, REORDER (SFD-F508)	F5-7
F5-3.7	LT, LOCAL TRANSLATION (SFD-F508)	F5-8
F5-3.7.1	Three Digit Code Translation, Operation of the LPA/LPB etc, Relays (SFD-F514)	F5-8
F5-3.7.1.1	Numerical Digit Translation, Operation of the N2-4 Relays (SFD-F514)	F5-8
F5-3.8	INC, INCOMING TRUNK CLASS (SFD-F508)	F5-8
F5-3.8.1	Terminating Class (SFD-F510)	F5-8
F5-3.9	TRK (1TR) OR TR2, FIRST OR SECOND TRIAL (SFD-F510)	F5-9
F5-3.10	TRS, TRANSFER START (SFD-F510)	F5-9
F5-3.11	CKG, CONNECT CHECK GROUND (SFD-F510)	F5-9
F5-3.11.1	Operation of the CKG4,5 and 6; TLC1,2 and LLC1,2 Relays (SFD-F511)	F5-9
F5-3.12	FGO-2; TF0,1,2,4,7 (2/5), TRUNK LINK FRAME (SFD-F512/F513)	F5-10
F5-3.13	A-(2/5) THRU G-(2/5), H7, CALLED NUMBER (SFD-F515)	F5-10
F5-3.13.1	Test Call Digit Control (SFD-F515)	F5-10

F5 SEIZURE OF CALLED COMPLETING MARKER BY INTERMARKER GROUP SENDER

After the intermarker group sender has received an advance signal from the calling CM and the calling CM has released (Part F4), the sender seizes a completing marker in the called marker group in competition with other intermarker group senders and IR's through preference and control circuits. The sender establishes a connection to the called completing marker through the IRMC and passes information to the CM that is used to complete the call.

F5-1 SEIZURE AND INPUT TO CALLED COMPLETING MARKER (SFD-F504,F505)

With the AV operated and LR relay normal in the IMG sender, the RS followed by the RA, RC, RD, RE and RB relays in the IRMC operate. The RB relay operating applies battery to the marker start STA or STB lead to begin seizure of the called completing marker. As will be seen later, the Z relay is operated and released on alternate calls so that the STA and STB start leads are alternately used on successive calls. Each sender or register is given preference to one completing marker for an MSA start and to another for an MSB start by cross-connecting MSA and MSB punchings on SFD-F504 to appropriate MS- punchings on SFD-F505.

F5-1.1 MARKER CONNECTOR RELAY CHAIN CIRCUITS (SFD-F505)

Three chain circuits are used in selecting a completing marker and closing the connector relays between the sender and the marker selected. The following are typical descriptions of chains also used in other connectors.

F5-1.2 CB- (MARKER CONNECTOR BUSY) RELAY CHAIN

An operated CB- relay indicates that the associated marker is busy to the connector. A CB- relay operated for a preferred marker advances the start lead to the next preferred marker. If the CB- relay for that marker is also operated, the start lead is advanced to the next preferred marker, etc.

F5-1.3 MS- (MARKER START OR PREFERENCE) RELAY OPERATE CHAIN

In periods of very light traffic (and assuming no markers busy) MS- relay operation is straightforward. A start signal from an intermarker group sender operates the MS- relay associated with the MS- terminal to which the start lead is cross connected.

In periods of heavy traffic one or more markers may be busy and two or more senders or registers may initiate marker requests either simultaneously or in rapid succession.

Assume that the first and last intermarker group senders (SFD-F504,F505) initiate simultaneous marker requests. Also assume that both start

leads are connected to MSO (that is both prefer marker 0). The MSO relay associated with each of the two senders will operate through the MSK cross-connection to ground in the marker. An early make contact on the MSO relay for the first sender will provide locking ground for that MSO relay before the break contact on the MSO relay for the last sender opens the MSK ground. Thus, both relays will operate and lock.

If, however, the last sender initiated a request for a marker slightly ahead of the first sender, the MSO relay for the first sender could not operate. On the other hand, if the first sender initiated a marker request first, a subsequent request by the last sender could operate the MSO relay for that frame.

F5-1.4 MS- RELAY WORK CHAIN

Since it is possible to operate two or more MS- relays at the same time, the work chain determines which MS- relay does the work. Ground for the work chain initiates in the marker at the MAK cross-connection. It should be noted that the work chain proceeds through contacts of each MSO relay in a reverse direction to the preference MSK chain. Contacts on the MSO relay for the first sender or register are, therefore, enabled to operate connector relays MA- through ME- whether or not any other MSO relay is operated.

Upon operation of the incoming register marker connector relays (MA- through ME-), the MCB- relays of the selected marker are operated over the MB lead (SFD-F506). The MCB- relays operate CB- relays in every connector having access to that marker (SFD-F505). It should be noted that an operated MA- connector relay contact bridges the break contact of the CBO relay in the start path so that the operated MSO relay is not released when the associated CBO relay operates.

If two or more MSO relays had operated for different intermarker group senders, the start lead for each of those which failed to get a marker would be advanced to the next preferred marker by operated CBO relays. If, however, no other marker was available no new MS- relay would operate until some marker became available at which time one or more MS- relays for that marker would operate. This would continue until all senders or registers had been served.

During periods of heavy traffic when all completing markers become busy, a traffic control circuit gates requests by senders and registers for CMs as described in the SFD-D1 section so that all senders and registers requesting service are served once before any is served a second time.

Relay MS- in operating releases the marker connector check relays MAK, MCK, and MSK (SFD-F505). The release of any one of these relays operates relay TM (SFD-F506) which starts marker timing.

F5-1.5 W AND Z RELAY CONTROL FOR TRANSFERRING START LEADS (SFD-F504)

If only one start lead was provided, then, under light traffic conditions, a particular connector might seize the same marker for every usage. If this marker is in trouble, all calls from that sender might be blocked. To prevent this and also to reduce the adverse effects of other circuit failures, two start leads are provided in each marker connector. By alternating the use of these start leads, two markers serve alternately as first choice markers, thereby providing more even wear on the marker connectors. This transfer is accomplished with a W and Z relay combination. The operation and release of relay MK provides the necessary transfer.

In the following description, assume that relay TRS (transfer start) is normal. The W and Z relay combination (SFD-F504) operates as follows:

(a) FIRST CONNECTOR USAGE

Marker seizure - Assume that relays MA- through ME- of the incoming register marker connector and W and Z of the preference control circuit are normal. Lead STA has continuity through the break contact of relay Z and lead STB is open. A marker is seized by operation of relay MS- via the MSA to MS cross-connection. Relay MS- causes the operation of relays MA- through ME-. Relay MA- operates relay MK in the preference control circuit (SFD-F504), which in turn operates relay W which locks.

Connector release - When the connector releases, release of the MA- relay releases relay MK which causes the Z relay to operate through the operated W. Relay Z locks operated from the ground of relay W which remains operated but the locking ground for W is now through the operated Z of the released MK. The operation of relay Z opens start lead STA and closes STB making it available for future usage.

(b) SECOND CONNECTOR USAGE

Marker seizure - At this time relays MA- through ME- are normal. Relays W and Z are operated. A marker is seized by the operation of relay MS- via the MSB to the MS- cross-connection. Relay MS- causes relays MA- through ME- to operate. The operation of relay MK, this time, opens the locking path of the W allowing it to release.

Connector release - The release of relay MK when the connector releases removes the Z relay holding ground, allowing it to release. Relay W remains released. The release of relay Z opens lead STB and closes lead STA making it available for the next connector usage. For subsequent usages the actions described above repeat.

F5-2 TIMING FUNCTIONS IN THE PREFERENCE CONTROL CIRCUIT

Timing circuits in the preference control circuit time CM seizure and the overall time the CM and IMG sender are connected by the IRMC.

F5-2.1 TRANSFER START TIMER (SFD-F510)

The transfer start timer allows an interval of 0.6 to 1.25 seconds for the IRMC to connect to a CM (unless all CMs are busy). If the connection is not established in this time, the preference control circuit transfers the start leads and gives a TRS signal to the CM to cause a trouble record to be taken showing that there is a transfer start condition.

The release of the SR relay in the IMG sender operates the TM relay (SFD-F510). The TM relay operates the TMI and also closes through the IM lead from the master traffic control to operate the IM relay. The IM lead will normally be grounded unless all CMs are busy, in which case operation of the IM relay is delayed until a CM becomes idle. The IM relay starts the TRS timer.

The TRS timer continues to time until the connector relays MA- through ME- operate. To check that the connector relays have operated, the MA-relay connects ground to the CKG lead to operate CKG1,2 relays. The CKG2 relay connects ground to the MTFC as a check that the connector relays operate. The MC- relay grounds the TC and TCI leads to operate the TC and TCI relays in the preference control circuit. The operated TC and TCI relays in the PC opens the path to the IM relay (SFD-F510) which stops and recycles the TRS timer.

If a marker is not seized in approximately one second, (providing markers are available as indicated by ground on the IM lead), the TRS tube will fire and operate the TRS relay. The TRS relay opens the start lead in use, closes the alternate one (SFD-F504), releases the TM relay in the preference control, and holds the TMI relay operated (SFD-F510). The TM relay is released to open the signal leads CWA and TCA (SFD-F510) to the traffic control circuit to prevent its timing out because of a marker connector trouble. The TM relay also releases the IM relay to recycle the timer (SFD-F510). The TMI relay is held operated to continue the overall timing before a marker is seized. The TRS relay locks operated through the TMI relay. When a marker is obtained over the new start lead, the TMI relay releases upon operation of the MK relay. The TRS relay remains operated over its locking contacts under control of the MK relay. The TRS relay transmits to the marker the fact that the transfer has taken place and this information is passed over the TRS lead. The marker causes a trouble record to be taken showing a TRS punch and indicating the intermarker group sender which encountered the TRS failure. Upon release of the marker, the MK relay, in releasing, will release the TRS relay.

F5-2.2 OVERALL TIMER (SFD-F507)

An overall timing circuit is provided which sounds the major alarm if an IMG sender calling for a marker has not been connected to one within 4.8 to 10 seconds. It functions as follows: After the AV relay in the IMG sender operates, release of the sender SR relay operates the TM relay in the preference control circuit (SFD-F510) concurrently with battery connection to the start leads for marker seizure. The TM relay operates the TML relay which starts the overall TM timer (SFD-F507).

For normal operation, a marker is seized before the timing interval has elapsed. This is indicated by the operation of the MK relay (SFD-F507) from the operated marker multicontact connector relays in the incoming register marker connector circuit. The MK relay releases the TM and TML relays. During the releasing time of the TM and TML relays, the TM tube timer circuit is recycled by discharging the A capacitor through the C resistance. The TML relay normal with the MK relay operated restarts the A capacitor charging circuit to time the release by the marker. If the marker releases the connector within the timing interval, the TM tube will not fire. However, should the marker exceed this time because of some trouble condition or should the marker connector relays remain operated due to a trouble, the TM tube will fire, operating the CA relay which brings in the major alarm and causes the IRMC- lamp at the JLK to remain lighted. This lamp normally flashes each time the MK relay operates as an in-use indication for the IRMC. When it remains steadily lighted, it serves as an IRMC alarm indication.

The MK relay releases at the end of the call upon release of the incoming register marker connector circuit multicontact relays, and discharges the A capacitor to recycle the TM timer for the next call.

F5-3 INFORMATION PASSED FROM THE IRMC TO THE CALLED COMPLETING MARKER

After the connector relays operate in the IRMC, a large group of leads are closed through to the completing marker in the called marker group, passing many pieces of information at the same time. The information transmitted from the IRMC to the CM is shown in the following table:

<u>Leads</u>	<u>Information</u>
MB	Connector Busy
TM	Overall Timer
TRL	Trouble Release
BT,MRL	Overall Time Out Release
ECN/OCN	Even/Odd Register Connector
RO	Reorder
LT	Local Translation
INC	Incoming Trunk Class

<u>Leads</u>	<u>Information</u>
TRK/TR2	First/Second Trial
TRS	Transfer Start
CKG	Connect Check Ground
FG0-2,	Trunk Link Frame
TF0,1,2,4,7(2/5)	
A-(2/5) thru	Called Number
G-(2/5),H7	

F5-3.1 MB, CONNECTOR BUSY (SFD-F506)

Closure of the MB lead operates the MCB- relays of the selected marker. The MCB- relays operate CB- relays in every connector having access to that marker (SFD-F505).

F5-3.2 TM, OVERALL TIMER (SFD-F506)

Closure of the TM lead operates the OAT relay which starts the OAT, over-all timer, in the called CM. The OAT timing interval, 9.6 to 15.4 seconds, is greater than the time required on any normal marker usage.

F5-3.3 TRL, TROUBLE RELEASE (SFD-F507)

When the marker finds it necessary to disconnect because of some trouble it connects ground to the TRL lead operating the TRL relay in the PC circuit. The TRL operating causes the PC to shift start leads and seize a new marker to make a second attempt to complete the call (SFD-F504).

F5-3.4 BT AND MRL, OVERALL TIME OUT RELEASE (SFD-F507)

If the called CM has an overall time out the MRL1 relay will operate which grounds the BT and MRL leads into the IMG sender operating the MTRL and MRL relays. The operation of these sender relays remove the start signal, and prevents a second trial (SFD-F504).

F5-3.5 ECN/OCN, EVEN-ODD REGISTER CONNECTOR (SFD-F507)

Closure of the ECN or OCN lead identifies the even or odd register marker connector used.

F5-3.6 RO, REORDER (SFD-F508)

If for some reason the intermarker group sender times out, the RO relay will operate. The RO operating grounds the RO lead into the CM operating the reorder RO relay which sets the marker to reorder.

F5-3.7 LT, LOCAL TRANSLATION (SFD-F508)

Ground on the LT lead from the intermarker group sender requests the CM to use the translator provided for a three digit local office code. This translator is used on incoming calls when the C digit conflicts with C digits of other office codes in the same marker group.

F5-3.7.1 Three Digit Code Translation, Operation of the LPA/LPB/etc., Relays (SFD-F514)

The intermarker group sender passes the called digits to the CM over the A-(2/5) thru G-(2/5), H7 leads. Ground on the A-(2/5) thru C-(2/5) leads operate the AC-(2/5) thru CC-(2/5) relays (SFD-F515). The CC-(2/5), B147, B258, B369, and BT-- relays operated will ground the C--- terminal operating the LPA/LPB/etc., (local translation) relay depending on the CM cross-connect.

F5-3.7.1.1 Numerical Digit Translation, Operation of the N2-4 Relays (SFD-F514)

The CM must determine which digits of the called number are the office code digits and which are the numerical digits, in order to operate the correct thousands, hundreds, tens and units digit relays. The operation of the LT and LPA/LPB/etc., relays operate the N4 (number translator) relay in the CM. The operation of the N4 relay will allow the grounded D-(2/5) leads to operate the TH-(2/5), HN-(2/5), T-(2/5) and U-(2/5) relays in the CM (SFD-F515). The operation of these relays will start NG (number group) seizure as shown on SFD-D402.

F5-3.8 INC, INCOMING TRUNK CLASS (SFD-F508)

On subscriber to subscriber IMG calls all the class relays in the IMG sender will remain normal grounding the INC lead operating the marker INC relay. The INC operating indicates that the call is TER class and is to a subscriber served by that marker group.

F5-3.8.1 Terminating Class (SFD-F510)

After the INC class relay operates the TCCK (trunk class check) relay operates in the CM (SFD-F511). With the TCCK and LPA/LPB/etc., relays operated the TER1,2 relays operate indicating that the call is terminating in this office. The operation of the TER1,2 relays cause the FLG (forward linkage ground) relay to operate which causes a linkage between the intermarker group trunk and the called line appearance, as shown on SFD-D603.

F5-3.9 TRK(1TR) OR TR2, FIRST OR SECOND TRIAL (SFD-F510)

With the TR1 relay normal in the PC circuit, ground is transmitted over the TRK (first trial) lead indicating to the CM a first attempt to complete the call.

If the CM encounters trouble failing to complete the call on the first attempt, the marker operates the TRL relay and then the TR1 relay in the PC circuit. With the TRL relay operated, ground is transmitted over the TR2 (second trial) lead indicating to the CM a second attempt to complete the call.

F5-3.10 TRS, TRANSFER START (SFD-F510)

If the transfer start timer in the PC circuit functions the start leads are transferred and with the TRS relay operated, ground is transmitted over the TRS lead into the CM to cause a trouble record showing a TRS punch and the intermarker group sender which encountered the TRS failure.

F5-3.11 CKG, CONNECT CHECK GROUND (SFD-F510)

Closure of the CKG lead between the IRMC and the CM, extends ground into the CM operating the CKG1,2 relays.

F5-3.11.1 Operation of the CKG4,5 and 6; TLC1,2 and LLC1,2 Relays (SFD-F511)

To provide a large number of ground and battery potentials to the marker circuit and to interconnect certain functional units, the CKG-; TLC1,2 and LLC1,2 relays will be operated.

Ground transmitted on the CKG from the IRMC will operate the CKG1,2 which operate the CKG4, 5 and 6 relays in the CM. The CKG2 relay operates the BX and ONX relays in the marker. The BX relay provides bias for some of the cross-detecting relays, while the ONX relay provides means for testing for crosses on the select magnet leads.

The CKG2 also operates the TLC1,2 (trunk link control) relays. The TLC1,2 relays provide battery potential for operating the trunk link connector relays and other miscellaneous ground and battery potentials.

The CKG4 relay operates the LLC1,2 (line link control) relays in the marker. The LLC1,2 relays provide battery potential for seizing the line link frame and operating the line link connector relays. The LLC1,2 relays also provide other miscellaneous ground and battery potentials.

F5-3.12 FG0-2, TF0,1,2,4,7(2/5), TRUNK LINK FRAME (SFD-F512/F513)

The trunk link frame number is in two parts, the frame tens number and frame units number. The tens number is on a 1-out-of-3 basis and is designated FG0-2. Frame units is on a 2-out-of-5 basis and is designated TF0,1,2,4, and 7. This information originated from cross connections in the intermarker group trunk and is passed to the CM from the operated relays in the intermarker group sender.

F5-3.13 A-(2/5) THRU G-(2/5), H7, CALLED NUMBER (SFD-F515)

On an intermarker group subscriber to subscriber call the called number consists of 7 digits, A-G. The digits stored in the intermarker group sender are passed to the CM in the called marker group through the IRMC over the A-(2/5) thru G-(2/5) and H7 leads. Each digit is received on a 2-out-of-5 basis consisting of a three digit office code, plus four numerical digits.

F5-3.13.1 Test Call Digit Control (SFD-F515)

On an incoming class of marker test the MTC (Master Test Control) circuit supplies the called number to the CM from the operated K(A-G) relays and A(0-9) thru G(0-9) keys or switches.

After the MC4 (marker connector) relay operates, the K relay in the MTC will operate. The K relay extends ground from operated A(0-9) thru G(0-9) Keys or switches on the MTC panel, operating corresponding K(A-G) relays in the MTC. The operated K(A-G) relays extend ground from the operated A(0-9) thru G(0-9) keys or switches to the CM operating the associated digit relays.

The K relay also operates the K1 relay in the MTC. The K1 is slow operating to insure its operation after all the K(A-G) relays. The operated K1 relay provides ground for the K(A-M) relay contact chain. The KG relay operated extends this ground to the H7 lead as an indication to the CM that no further digits are to be expected.

SECTION F, PART 6

CONNECTION TO THE TRUNK LINK, NUMBER GROUP, LINE LINK, NETWORK
CONNECTION AND MARKER RELEASE - CALLED MARKER GROUP

Index

	<u>PAGE</u>
F6 CONNECTION TO THE TRUNK LINK, NUMBER GROUP, LINE LINK, NETWORK CONNECTION AND MARKER RELEASE - CALLED MARKER GROUP	F6-2

F6 CONNECTION TO THE TRUNK LINK, NUMBER GROUP, LINE LINK, NETWORK
CONNECTION AND MARKER RELEASE - CALLED MARKER GROUP

After the called CM has been seized and has received input information through the IRMC from the intermarker group sender, it proceeds to connect to the TL (trunk link) frame which contains the intermarker group trunk. After the TL preference circuit functions, the CM connects to the intermarker group trunk. Trunk class information is passed from the trunk to the marker. The completing marker determines the location of the trunk on the trunk link and operates control relays and select magnets.

In a No. 5 crossbar office, there is no permanent or prearranged association of directory numbers with switch and vertical locations on the LL (line link) frames. The CM, after translating the called number, must determine which of the many line locations in the marker group is associated with that particular directory number. The completing marker obtains this information from the NG (number group) frame. The NG frame has a large cross connectable memory, line location to directory number, to which the CM applies for the necessary translation.

After the directory number has been translated, the LL containing the called line is seized to enable completing marker control of the desired select and hold magnets. This connection is referred to as FLG (call forward linkage).

Once the trunk and line location have been identified, a connection between the line and trunk are made by closing the line switch and junctor switch crosspoints on the LL, and the junctor switch and trunk switch crosspoints on the TL. The select magnets and hold magnets involved in closing the specific crosspoints depend on the location of the line on the line switch, the trunk on the trunk switch, and the channel selected. After crosspoints are closed, the channel is checked for crosses, continuity and double connections. The NG (number group) releases and the ringing switch crosspoints are closed.

After the called CM has verified the successful completion of the double connection test, ground test and closure of the ringing switch crosspoints, ringing is applied to the called line. The completing marker then checks that linkage is properly set up and proceeds to disconnect and restore to normal. Once the called completing marker has disconnected the intermarker group sender releases.

On an intermarker group call the trunk link, number group, line link, network connection and marker release in the called marker group are almost identical to the same operations performed on an incoming call. See SFD and SCD Sections I B, D4, D5, D6, and D7 for a description of the trunk link, number group, line link, network connection and marker release operations in the called marker group.

SECTION F, PART 7

MAINTENANCE-INTERMARKER GROUP CALL

Index

	<u>PAGE</u>
F7 MAINTENANCE-INTERMARKER GROUP CALL	F7-2
F7-1 USE OF CLASS OF TEST TABLES	F7-2
F7-2 INTERMARKER GROUP SENDER (IMS) CLASS OF TEST SUBSCRIBER TO SUBSCRIBER - CALLING MARKER GROUP (SFD-F702, F703)	F7-3
F7-3 INTERMARKER GROUP TRUNK TEST SUBSCRIBER TO SUBSCRIBER - CALLING MARKER GROUP (SFD-F704, F705)	F7-3

F7 MAINTENANCE-INTERMARKER GROUP CALL

This part of the F Section covers some aspects of the use of the master test frame to detect, locate and clear trouble on intermarker group calls.

On an intermarker group call the simulation chart, associated trouble record card and marker test charts are very similar to the same operations performed on an outgoing and incoming call. See SCD-C8 and SCD-D9 for a description of the simulation chart, associated trouble record card and marker test charts.

D7-1 USE OF CLASS OF TEST TABLES

The class of test tables shown on SFD-F702 through F705 summarize, in tabular form, the key(s) and switch(es) used to establish a particular class of test. A single line is used to separate a particular function with its associated figure, option, key, or switch. The double line within the single lines is used to separate the various options on vintages of master test control frames. The note column and sheet notes are as follows:

- (a) Note 1 indicates that all key(s) or switch(es) must be operated to make a proper test frame setup for the particular class of test. It is suggested that known working equipment must be selected for test.
- (b) Note 2 indicates the key(s) or switch(es) to be used to simulate the trouble record. Refer to simulation tables in SFD-C802, C804, or C806 and their associated colored trouble record card on the opposite pages (C803, C805, or C807) of the simulated table selected. The tables and colored trouble record cards, along with the class of test tables, will assist the maintenance personnel in selecting the proper key(s) or switch(es) to be operated in order to properly simulate the reported trouble condition.
- (c) Note 3 indicates those key(s) or switch(es) used for additional marker tests but they are not necessarily required for trouble record test or simulation test.

F7-2 INTERMARKER GROUP SENDER (IMS) CLASS OF TEST SUBSCRIBER TO
SUBSCRIBER - CALLING MARKER GROUP (SFD-F702,F703)

On an intermarker group sender class of test, the MTC (master test control) circuit connects to a CM in the calling marker group. The MTC instructs the calling marker to set up a test connection, either from the originating test line or through the no-test connector, to an intermarker group trunk and to connect to that trunk a particular intermarker group sender as illustrated on SFD-F702. The intermarker group sender is given a test signal which it forwards to the CM in the called marker group which blocks completion of the test call and forces a trouble record showing the information transmitted from the sender to that marker. If the REC key is operated at the MTC panel, a trouble record is taken by the CM in the calling marker group showing the information transmitted to the intermarker group sender.

F7-3 INTERMARKER GROUP TRUNK TEST SUBSCRIBER TO SUBSCRIBER - CALLING
MARKER GROUP (SFD-F704, F705)

The IAO class of trunk test is used for testing subscriber to subscriber intermarker group trunks where the test is to be completed to the trunk test circuit terminating test line in the called marker group. The MTC (master test control) circuit directs the CM in the calling marker group to set up a connection to the intermarker group trunk. The CM in the called marker group completes the connection to the terminating test line as illustrated on SFD-F704.

